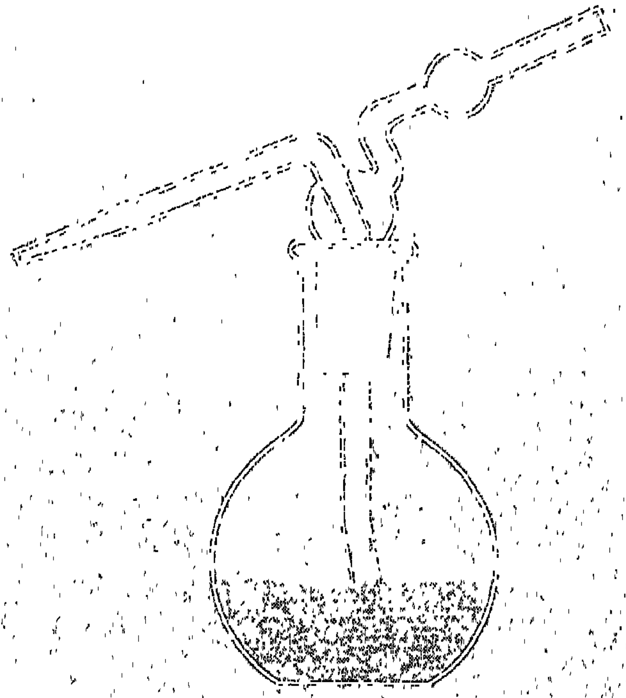
MANUAL

FOR

SENIOR SECONDARY

CHEMISTRY XII

FOR NATIONAL OPEN SCHOOL



H. C. GUPTA

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MANUAL

FOR
SENIOR SECONDARY

CHEMISTRY KIT

FOR NATIONAL OPEN SCHOOL

H. O. GUPTA

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

March 1994

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FOREWORD

An experimental package for chemistry practicals for the open school students of senior secondary level has been developed by the NCERT in collaboration with the National Open School (NOS) It is hoped that this package will be useful not only for the Open School System but also for those senior secondary schools in the country where regular laboratory facilities may not exist due to the high cost of setting up of a chemistry laboratory The package consists of a chemistry kit, kit manual and student information sheets The kit contains glassware, chemicals and low cost general laboratory items The kit manual details, interalia, the laboratory safety regulations and teacher's notes on each tried out experiment It is expected that the student information sheets detailing instructions for the students to do the experiments in the resource centres and to record their observations in these sheets would qualitatively improve the performance of the students in the practicals.

I thank Dr. H.O. Gupta, Reader, Workshop Department, who has made a good beginning in bringing out this experimental package for the open school students and Mrs. S. Mitra of the NOS for active association with this project as also to Prof. R.N. Mathur, Head, Workshop Department and his colleagues and all the subject experts and participating teachers for their contributions in trying out the experiments and reviewing the manuscripts

I hope this package will be usefol for enabling the students to do their practicals at low cost and in the absence of a regular laboratory. Suggestions and comments for further improvement of this package are invited.

A K. Sharma
Director
National Council of Educational Research & Training

New Delhi

PREFACE

In the last decade, open learning systems have gained popularity in India These systems provide access to education to drop out, women and other disadvantaged persons of the society, and are likely to expand in near future One of the challenges faced by these systems is in implementing courses which require experimental work. In many areas of India including the remote areas, there is practically no infrastructure facilities available for experimental work. Consequently, a stop gap arrangement would be to supply compact protable and low cost kits to be placed at selected Resource Centres.

On request of the National Open School, the NCERT has taken up a project of design and development of prototype of Physics, Chemistry and Biology kits at Sr. Secondary level The chemistry kit is the first which has been developed by the Workshop Department of the NCERT It contains all the materials required for carrying out all the experiments prescribed by the National Open School for Senior Secondary students in chemistry alongwith kit manual and students information sheets One kit can be used by about 18 students at one time It is a low cost kit which could also be used in the formal system, at places where adequate laboratory facilities are not available.

The major credit for developing this chemistry kit package goes to Dr. H O. Gupta, Reader in Chemistary in this Department. I also gratefully acknowledge the contributions of the following experts and teachers of various Institutions for the development of this package, Dr P.S Jaiswal, Hansraj College, Delhi, V C S Rao, Sri Venketeshwara College, Delhi, Vijay Sarda, Zakir Husain College, Delhi; A.C. Handa, Hindu College, Delhi, Sanjeev Kumar, Deshbandhu College, Delhi, S.C Sharma S.G.T.D Khalsa College, Delhi; Bhupendra Mehta, Swami Shradha Nand College, Alipur, Brahm Prakash, DESM, NCERT, Mrs. S Mitra, National Open School; R C Gaur, Mount Carmel School, Shri P.R Juneja, HBDAV Sr Sec School, Yusuf Sarai, R.S. Sharma, K.V. AFA Tughlakabad; Mrs. Radhika Mathur, DPS; Mrs. Pramila Jain, K.V., Majsid Moth, Sadiq Nagar and Mrs. V K Jetley, K.V., JNU Campus, New Delhi.

I am thankful to all the staff members of the Workshop Department, NCERT, who were involved in the development of the kit, particularly, Shri K.L. Mathur, Technical Officer, Miss Mohini Mansani and Sh. S S. Wadhwa and Shri Anil Kumar for the art work

R.N. Mathur
Head, Workshop Department
NCERT

CONTENTS

1. INSTRUCTIONS FOR RESOURCE (STUDY) CENTRES 1
2. ASSEMBLY OF EQUIPMENT 3
3. GENERAL LABORATORY TECHNIQUES 8
4. PREPARATION OF REAGENTS 16
   (A) PREPARATION OF REAGENTS
   (B) PREPARATION OF HYDROGEN SULPHIDE (H_2S) GAS FOR QUALITATIVE ANALYSIS
5. SAFETY IN THE RESOURCE CENTRE 19
   (A) DISPOSAL OF WASTE CHEMICALS
   (B) SAFETY REGULATIONS
   (C) FIRST AID
6. TEACHER'S NOTES ON EXPERIMENTS 23
7. LIST OF ITEMS IN THE KIT 48

APPENDIX : LIST OF EXPERIMENTS 61

1. INSTRUCTIONS FOR RESOURCE (STUDY) CENTRES.

The following guidelines may be used to set up a make shift laboratory. Before using this Chemistry Kit, following guidelines may be followed :

The experiments must be carried in a sufficiently large room with cross ventilation and adequate illumination. If possible, the room should be fitted with an exhaust fan.

Experiments should be performed by students in batches of 2 or 4 students each

For a batch of 4 students, a wooden table of 6'x6' should be used. One or two such tables may be provided in the room.

If the room is not equipped with a tap and sink, adequate arrangements for water supply and waste disposal must be made. Water should be stored in a large plastic bucket fitted with a tap, if possible For waste disposal a plastic bucket should be kept near the working table for liquid wastes. Solid wastes such as filter papers, match sticks, broken glass etc. should be dropped in a large empty tin labeled "SOLID WASTE".

Ordinary water is not suitable for certain experiments, for these, distilled water (or de-ionised water) is necessary. Distilled water may be bought in bottles from Petrol Pumps. In some areas a very good substitute is rain water. This is collected best in the middle of a shower in clean plastic buckets. If kept covered it may be used later during the course of the year.

The following additional Chemicals are needed for use with the Kit and should be purchased locally and stored properly.

(i)	Concentrated Sulphric Acid	500 CM^3
(ii)	Concentrated Hydrochloric Acid	500 CM^3
(iii)	Conc. Nitric Acid	500 CM^3
(iv)	Acetic Acid	500 CM^3
(v)	Liquor Ammonia	500 CM^3

The above mentioned Chemicals are available in 500 CM^3 packs.

(vi) Kerosene oil for use in burners and for storage of sodium metal

(vii) Sodium metal

(viii) A Sand Bucket for fire safety purposes.

A small wooden almirah or cupboard should be kept for storage of thse additional Chemicals.

Under no circumstances must untrained persons be permitted to enter for work in the Resource room with the kit; or to handle any additional Chemicals or apparatus.

For safety of the students, 4 low cost Aprons or laboratory coats and safety glasses should be provided.

A Black board and chalks should be provided for instructions. A Hand-made chart of safety precautions and Regulations for handling of chemicals should be displayed in the resource room If possible, a chart of first aid should also be displayed.

CHEMISTRY KIT

This kit consists of two parts. The Iron Box and the Corrugated Sheet box. The corrugeted sheet box contains mainly wooden shelves for arranging the bottles containing chemicals and reagents The wooden shelves are designed such that the bottles can be fitted in them according to their sizes and can be placed one above the other enabling them to be attached with hooks There is a provision to assemble two racks consisting of three shelves in each. Check the items in the boxes according to the list of items given in chapter 7. Replenishment of chemicals and apparatus (if broken/lost) in the Kit should be made from locally available sources. Each item in the kit should be checked and compared with the list of items given in the chapter 7.

HANDLING AND STORAGE OF CHEMICALS

Warning of 'POISION", "FIRE HAZARD" etc. must be put on the appropriate chemical bottles in the Resource Room. Maintain a record of the chemicals used in a Register. When not in use, the kit box and chemicals cupboard must be kept locked.

Concentrated Acids should be stored on the lower shelf of the cupboard. Sufficient amounts of these acids, when needed, may be transferred to small labelled containers.

Dilute solutions of acids, bases and other reagents should be prepared in advance of the class and kept in bottles with proper labelling.

Sodium metal must always be kept under kerosene oil. Small pieces may be cut with a blade by transferring them to a China dish containing Kerosene oil.

The bottle of liquor Ammonia must be cooled under Cold Water (preferably running water) for at least 1/2 an hour before opening. The bottle should be opened with the mouth of the bottle away from the face of the students. Dilute solutions of Ammonium hydroxide may be made according to the need and stored in a closed labelled bottles.

The instructions given in the next chapter for assembly of the various equipment and apparatuses to be used for performing experiments with this kit should be properly followed.

2. ASSEMBLY OF EQUIPMENT

(i) ASSEMBLY OF KEROSENE BURNER

Burner has four components as shown in the diagram (Fig. 2.1)

A. Kerosene container

B. Wick holder

C Cylindrical mesh (Inner chimney) of narrow diameter

D. Cylindrical mesh (Outer chimney) of wider diameter.

Following steps are followed for the assembly of burner.

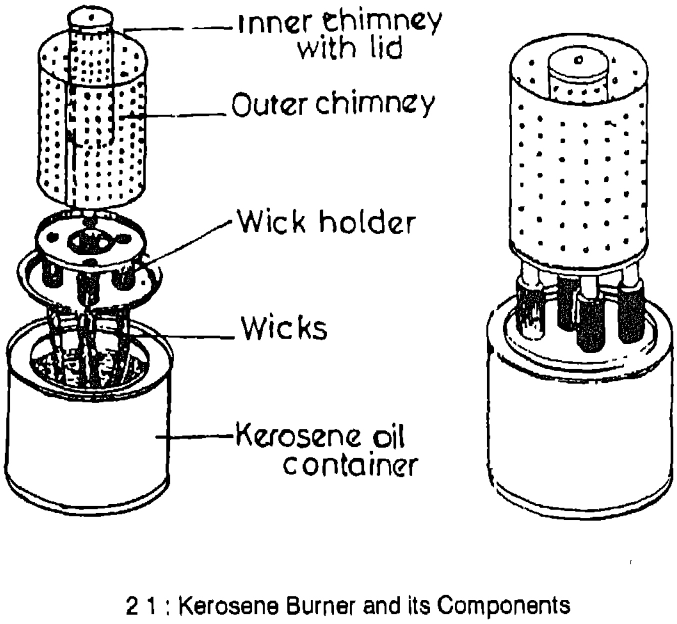
(i) Fill the Kerosene container with Kerosene

(ii) Fix the wicks in the wick holder

(iii) Now fix this wick holder over the kerosene container

(iv) Place narrow cylindrical mesh with lid to cover the wicks

(v) Finally, fix the wide cylindrical mesh over the narrow cylindrical mesh.



2 1 : Kerosene Burner and its Components

INSTRUCTIONS FOR USE

Remove both the cylindrical mesh and check that all the four wicks are equally projected out of the holder. Now, replace the narrow cylindrical mesh. Light the wicks with a match stick carefully. Put back the outer cylindrical mesh.

After finishing the work, the burner is put off by putting either a wire gauge or a flat iron plate on the top of the wire meshes and waiting till the burner extinguished and cools.

(ii) **ASSEMBLY OF STAND**

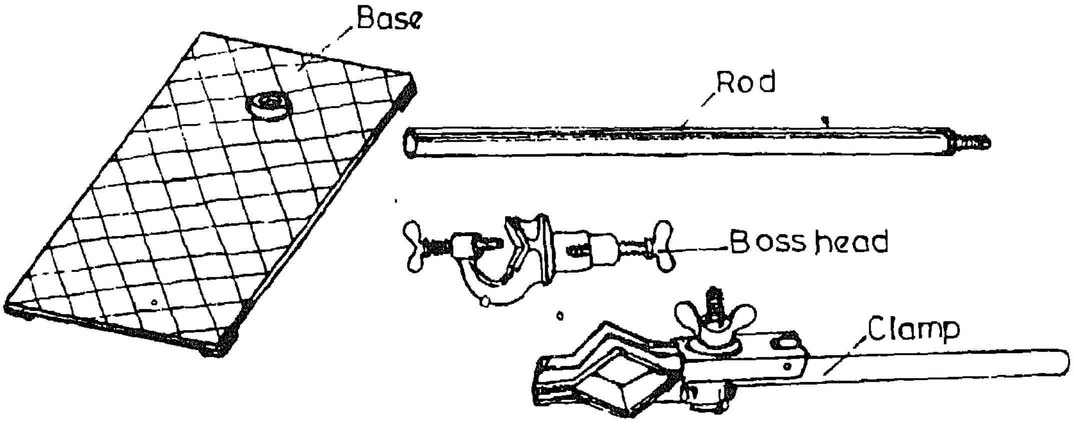
Components of the stand are · (Fig 2.2)

A Heavy metal base with hole

B An iron rod with thread

C. Boss head

D Clamp extension



2 2 : Laboratory Stand Components

Following steps are carried out for the assembly :

i) Place the metal base on a flat surface

ii) Hold the iron rod with thread vertically into the hole of the base.

iii) Now rotate the Iron rod clockwise until it is tightly fixed into the base

iv) Now fix the boss into the iron rod at a convenient height with the help of screw.

v) Finally fix the clamp extension into the boss as shown in the figure 2.3

(iii) **ASSEMBLY OF BURETTE**

Main components of the burette are : Fig. 2.4 a.

A. A hard glass tube of uniform cross section and 25.0 cm^3 capacity with division to measure 0.1 cm^3

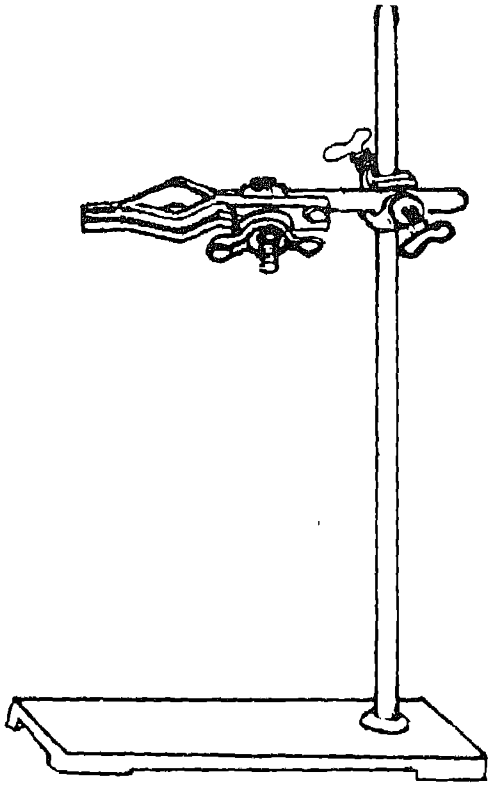
B. A small PVC tube

C. A glass tube with a jet at one end

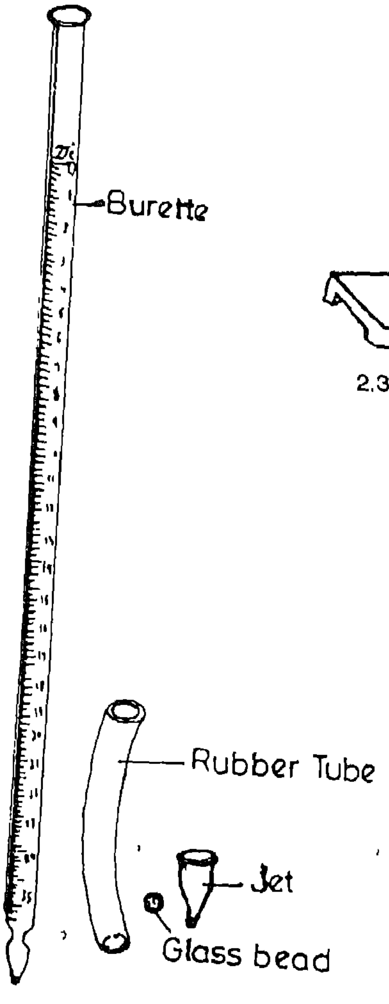
D. A small glass bead

Following steps are carried out for the assembly :

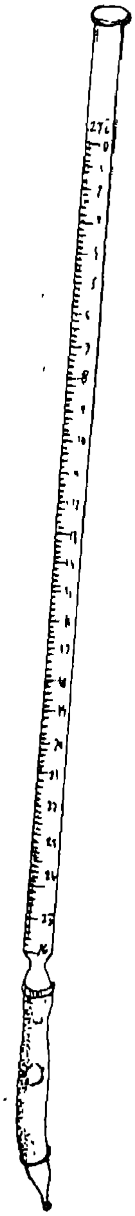
i) Insert the glass bead into the PVC tube so that the bead is in the middle position.



2.3 : Laboratory Stand (Assembled)



2 4 (a) : Burrette with parts



2.4 (b) : Assembled Burrette

ii) One end of this tube is slipped over the wider side of the glass jet.

iii) This assembly at (ii) is then connected to the narrow end of the long glass tube through the other end of PVC tube (fig. 2.4b)

INSTRUCTION FOR USE

For releasing the liquid from the burette, just press the PVC tube at the place of the bead with your fingers.

(iv) ASSEMBLY AND USE OF APPARATUS TO PREPARE GASES

Gases lighter than air are collected by the downward displacement of air Gases heavier than air are collected by the upward displacement of air. Finally, gases which are insoluble in water are collected over water.

To assemble the apparatus for gas preparation, following pieces of apparatus are needed :

A. Boiling tube with side tube (commonly called filtration tube)

B. Thistle funnel

C. Cork bored with single hole

D. Plastic tubing

E. Plasticine or wax

F. Plastic trough

G Beehive shelf

H. Stand

I. A small glass tube bent at 90°

INSTRUCTIONS FOR ASSEMBLY FOR GAS PREPARATION :

Insert the thistle funnel into the cork, fitted into the boiling tube with side tube Now with plasticine or wax, plug the air gaps between the mouth of test tube and cork to prevent the escape of gas. Clamp the boiling tube with thistle funnel to the stand. Connect the side tube of the boiling tube and the bent glass tube through a plastic tube

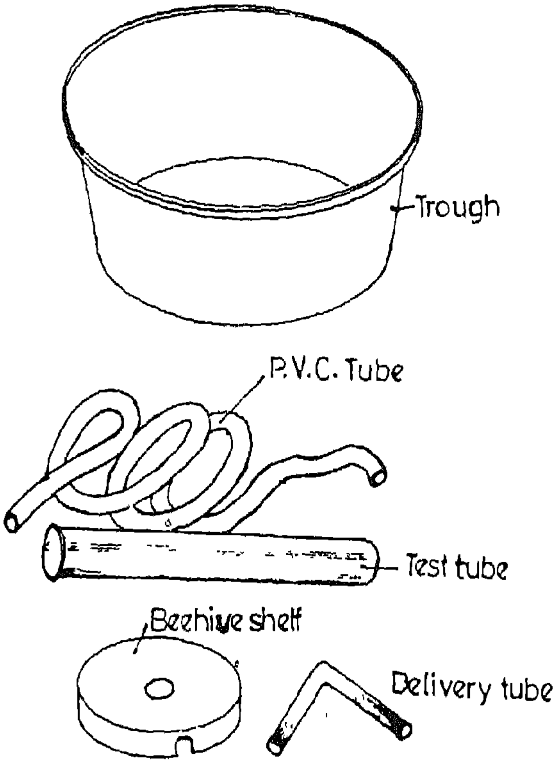
COLLEECTION OF GASES

(a) GASES INSOLUBLE IN WATER

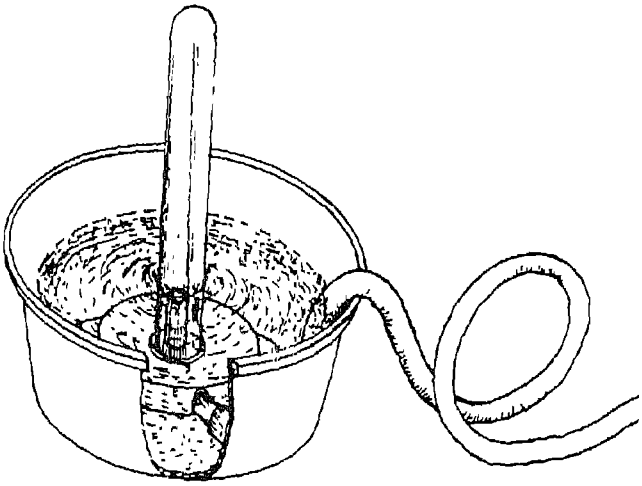
Take the plastic trough and place the beehive shelf at the centre of the trough. Fill the trough with water till it covers the beehive shelf. The apparatus and assembly for the gas collection in water is shown in figures 2.5(a) and (b) respectively. Separately fill the test tube in which gas is to be collected with water and keep it ready. Take the necessary chemicals for preparing a gas in the boiling tube. Press the mouth of the test tube full of water with your thumb and lower it in inverted position over the beehive shelf such that water does not flow out of the test tube. Now heat the boiling tube and collect the gas by the downward displacement. After the test tube is full of gas, remove the test tube while keeping its mouth downward and cork it. Fill required number of test tubes in a similar manner.

(b) GASES HEAVIER THAN AIR

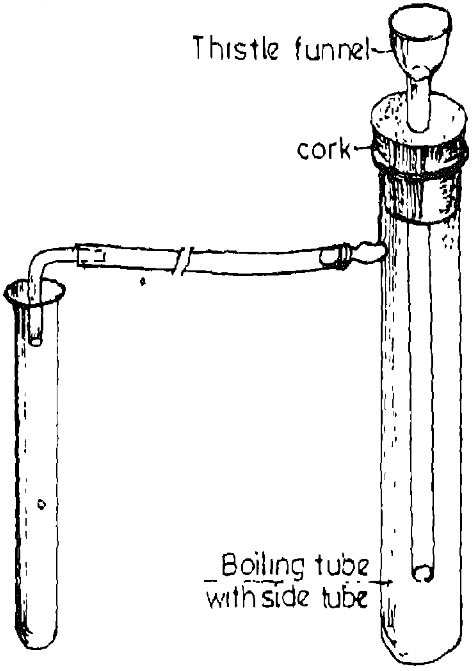
In this case, the bent glass tube is lowered into an empty test tube which is vertically



2.5 (a) : The components of assembly for collecting the gas by displacement of water



2 5 (b) : Assembly



2.5 (c) : Assembly showing the collection of gas heavier than air

held as shown in figure 2.5(c).

(c) GASES LIGHTER THAN AIR

The test tube in which gas is to be collected is clamped to a stand in inverted position. Now bring the bent glass tube at the mouth of the test tube. Heat the chemicals in the boiling tube and collect the gas in the test tube and cork it.

3. GENERAL LABORATORY TECHNIQUES

(i) CLEANING THE APPARATUS

Any trace of impurity can affect the course of a chemical reaction and spoil the result of the experiments performed. Thus, cleaning of the glass apparatus is very important before they are used in any experiment.

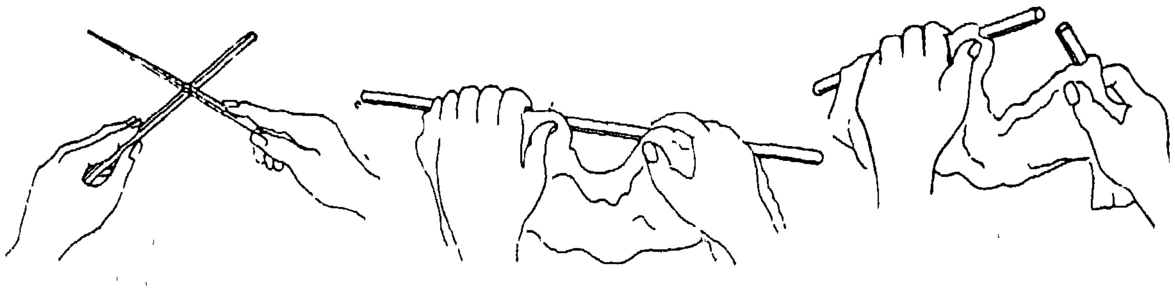
1. Clean the glass apparatus by scrubbing with washing powder commonly available in the market.
2. If necessary, use a suitable size of brush to clean the inner surface of the glass apparatus e.g. test tubes, conical flasks, etc.
3. Wash the apparatus thoroughly with water, and ensure that no traces of washing powder remain stick to the glass apparatus.
4. If necessary, rinse the apparatus with distilled water. (as per experimental requirements)
5. Keep the apparatus inverted on clean surface of the table or on a stand (for test tubes, conical flasks etc.) for quick drying.

(ii) SOME SIMPLE TECHNIQUES

All the experiments in chemistry require setting up of apparatus. It involves the cutting and bending of glass tube, drawing the jet from glass tube, boring of cork, etc. Following instructions should be followed for these simple operations.

A. *CUTTING OF GLASS TUBE*

1. Measure the required length of a suitable glass tube and place it on a flat surface.
2. Hold it with left hand near the point where the cutting is to be done. Make a single straight scratch with the help of triangular file by drawing it through its full length with moderate pressure. (Fig. 3.1a)



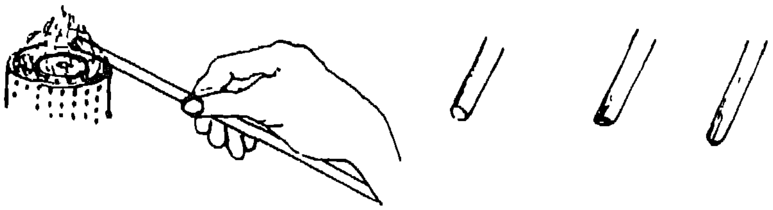
3.1 (a) : Cutting of a glass tube 3.1 (b) : Holding the glass tube 3.1 (c) : Breaking the glass tube

3. Hold the glass tube from the back side of the scratch putting thumbs on either side of the scratch Fig. (3.1b).

4. Press the tube gently outward. The tube will break into two pieces Fig. (3.1c).

5. If tube does not break repeat scratch at the same point and break it by the same method.

6. The freshly cut ends are sharp which may cause injury to the hands. Round off the ends by rotating the tube end in the flame for a short time. Fig. (3 1d)

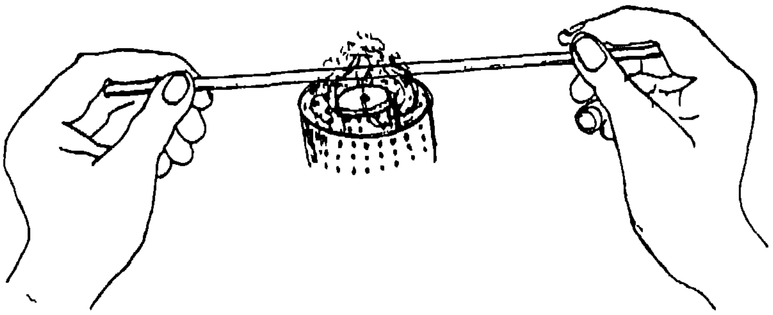


3.1 (d) : Rounding off the ends of the cut tube

B. *BENDING OF A GLASS TUBE*

1. Rotate the portion of the glass tube to be bent in the flame of the burner. (Fig. 3.2)

2. Heat till the glass tube becomes soft enough and tends to bend by its own weight.



3.2 Bending of a glass tube

3. Maintain the desired angle by holding the glass tube ends with both hands

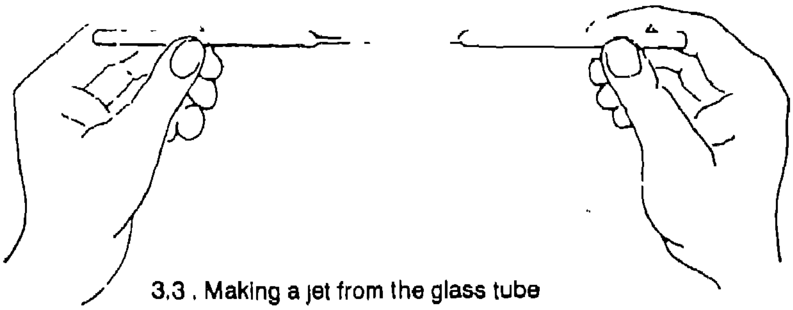
4. Press the bent limbs to make them coplanar.

C *DRAWING A JET FROM GLASS TUBE*

1. Take a glass tube of a suitable length and round off its sharp edges by gently heating for some time.

2. Hold the glass tube horizontally on flame and rotate it with both hands till it becomes soft (Fig. 3.3)

3. Withdraw the softened hot tube from the flame and draw the two ends apart and hold till it cools down.

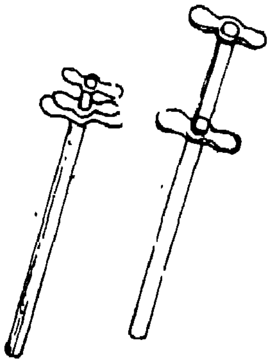


3.3 . Making a jet from the glass tube

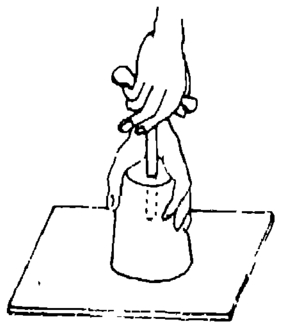
4. Place it on table and cut it into two jet with the help of glass-cutting file. Round off the sharp edges in the flame for short while.

D. *BORING A CORK*

1. Take a good cork free from cracks and holes. Check that it should fit tight in the apparatus for which it is needed.
2. Wet the cork with water and soften it by rolling under your shoe.
3. Now select a cork borer whose diameter is slightly less than that of the glass tube or rod for which the hole is needed.
4. Place the cork on the table with its narrow end upward and hold it with in the left hand.
5. Make a round hole in its centre by pressing the borer gently inward Fig. 3.4(a) and (b).



3.4 (a) : Set of borers



3.4 (b) : Boring a cork

6. Make a similar mark also on the opposite side of the cork. Dip the cork borer into the water, remove it and place it vertically over the mark on the cork.
7. Press it downward with twisting motion into the cork till borer reaches to the half way. Pull out the borer from narrow end and remove the cork material in it by means of a needle provided with the set of borers.

8. Now place the cork upside down. Again insert the borer in cork through the mark till it meet already made hole.

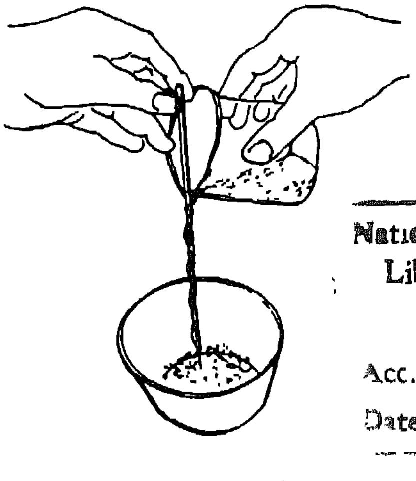
9 While boring, take a precaution that hole should be straight While inserting the glass tube into the hole, hold the cork in hand and push the tube gently through it with a rotatory motion. To avoid accidental breakage, lubricate the tube with water or soap solution

E. *SEPARATION OF PRECIPITATES*

In the chemical reactions, an insoluble solid, called a precipitate, can easily be removed by the decantation or gravity filtration.

(a) DECANTATION

1. Allow the precipitates formed to settle to the bottom of container, until the liquid above is transparent.
2. Hold the glass rod vertically with the left hand and touch it to the container.
3. Pour the liquid carefully to another container by tilting it (Fig. 3.5) alongwith the glass rod.
4. The holding of glass rod vertically helps in transferring the liquid to other container without any spilling and the precipitates are also not disturbed.



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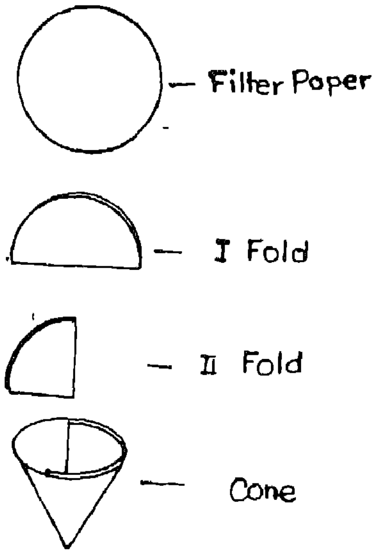
3.5 Decantation method

(b) GRAVITY FILTRATION

In the gravity filtration, the mixture containing the precipitate is poured through a filter system comprised of a conical funnel lined with filter paper.

1. Take a circular filter paper and give four folds to it Then hold the three folds together and press a little from the corners. The filter paper acquires a cone shape as shown in figure 3.6(a).

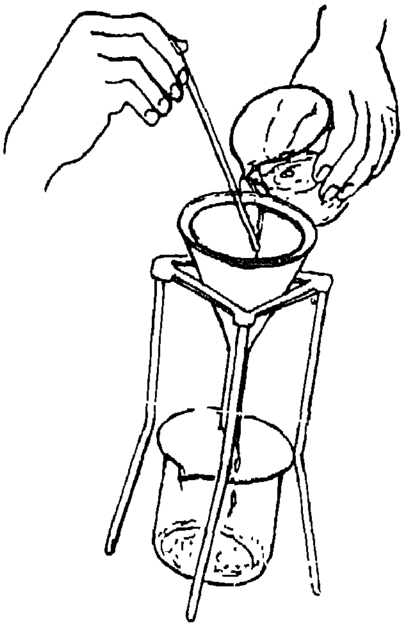


3 6 (a) : Folding of filter paper

2. Place the filter paper in the funnel and fix it on the stand or on the tripod.

3. Keep another container below the funnel to collect the filtrate.

4. Transfer the liquid along with precipitate with the help of a glass rod, as mentioned earlier, to the funnel Fig. 3.6 (b). Collect the filtrate in the container below it and remove the filter paper from the funnel and dry the precipitate.



3.6 (b) : Filteration

F. *USE OF BURETTE*

1. Wash the burette thoroughly with water. Put a little solution to be used in it. Now hold the burette horizontally and rotate it gently so that the whole surface gets rinsed out with the solution. Drain the solution through the jet.
2. Clamp the burette vertically, maintaining the height in such a way that the jet of the burette enters the mouth of the titration flask. This prevents the spilling of solution (coming through the jet) outside the flask, while performing the experiment.
3. Place a funnel at the mouth of the burette. Fill it with the desired solution, a little above the etched mark at the top.
4. To displace any air bubble present, release the small amount of solution by pressing the PVC tube at the position of the glass bead.
5. If necessary, fill the burette again, to maintain the solution level upto the etched mark.
6. Read the burette by holding a white paper on back and looking straight (at eye level) to the meniscus (a curved surface of liquid).
7. For all the colourless solutions, read the lower meniscus and for the coloured solutions (e.g. $KMnO_4$ solutions, etc.), read the upper meniscus.
8. During the experiment, use left hand pressing the tube at the glass bead position and hold the titration flask in the right hand.

G. *USE OF PIPETTE*

1. Wash the pipette with water.
2. Dip the pipette into the solution with the tip nearly touching the bottom of the container. Suck a little solution by putting the upper end in the mouth.
3. Remove the pipette from the mouth and close its upper end with the help of the forefinger immediately. Tilt and rotate it in such a way that the inside surface gets rinsed out completely with the solution.
4. Remove the forefinger from the upper end and drain the solution through the lower end (i.e. tip) only.
5. Suck the solution again, a little above the etched circular mark and close the pipette immediately with the forefinger.
6. Release the solution, carefully, so that the lower meniscus, in case of colorless solution (or upper meniscus in case of coloured solutions) is at the level of the circular edged mark.

7. Introduce the tip into the titration flask and discharge the solution, but removing the forefinger. The whole solution flows automatically, except a little at the tip.

8. Do not blow out the solution at the tip, but simply touch the tip to the inner wall of titration flask 2-3 times. The part of the solution passes into the flask and neglect the remaining amount still at the tip.

9. Pipettes are dangerous, if used incorrectly, for following reasons :

   a) Sucking of the poisonous solutions, volatile liquids, concentrated acids, alkalies, etc. should be avoided as these may cause injury due to inhalation.

   b) The horizontal placement of pipette at the laboratory bench can result in the contamination of the mouth piece. So, always keep the pipette vertically in a stand.

H. *USE OF TITRATION FLASK*

1. Wash the titration flask (a conical flask of convenient size) thoroughly with water, but never rinse it with any of the test solutions

2. Pipette out the solution into the titration flask and keep it below the jet of the burette, preferably by holding it with the right hand.

3 Put a white glazed paper (may be torn from a magazine) or glazed porcelain tile under the titration flask, i.e. on the base of the stand. This helps in observing any slight colour change of the solution, due to indicator, at the end point in the volumetric analysis.

4. Shake the flask continuously while performing the titrations.

5. Before every titration, wash the flask thoroughly with water.

I. *HEATING OF SOLUTIONS/LIQUIDS*

Heating of a solution is done for the following purposes

(a) concentrating the solution

(b) mixing or dissolving the solid components in a solvent

(c) for carrying out the reactions at higher temperatures.

   1. Carry out the heating in any glass apparatus depending upon the requirement (i.e. in test tubes, conical flask, china dish etc.)

   2 While heating 'bumping' takes place which may cause spilling of liquids. Add a few small pieces of porcelain to avoid it (e.g broken china dish, cups etc.)

3. If heating the solution is carried out in the test tube, fill it not more than 1/4. Hold it at angle of about 45° and heat on a small flame with continuous shaking.

4 For heating of solution in beaker, china dish, conical flasks, etc , place a wire gauge on the tripod stand and keep the container over it.

5 For heating small amount of solutions to dryness, heat them in a china dish.

4. PREPARATION OF REAGENTS

(a) In this section, instructions are given for preparing various reagents to be used in the experiments Prepare these reagents and store them in the containers provided in the Kit and place these in the shelves of the racks.

REAGENT	QUANTITY FOR REAGENT FOR 100CM^3 OF SOLUTION
Dilute Sulphric Acid (2.5M)	14 cm^3 of conc. sulphuric acid (SG = 1.84, 18M) in water
Dilute Hydrochloric Acid (5M)	42 cm^3 of conc. hydrochloric acid (SG = 1.16, 12M) in water
Dilute Nitric Acid (5M)	31 cm^3 of conc. nitric acid (SG = 1.42, 16 M) in water
Dilute Acetic Acid (5M)	17 cm^3 of glacial acetic acid in water (SG = 1.05, 17M)
Dilute Sodium Hydroxide (2M)	8g of Sodium Hydroxide in water
Dilute Ammonium Hydroxide (5M)	24cm^3 of liquor ammonia in water (SG = 0.88)
Ammonium oxalate (0.25M)	3.5g of ammonium oxalate in water
Ammonium molybdate (0.5M)	Disolve 7.5g of Ammonium molybdate in a mixture of 7.0 cm^3 of liquor ammonia, and 15 cm^3 of distilled water. Add 20g of ammonium nitrate. Dilute with water to 100 cm^3.
Barium Chloride (0.25M)	6.0g of Barium Chloride in water
Dimethylglyoxime (1% Alcholic)	Dissolve 1.0g of dimethylglyoxime in ethyl alcohol or denatured spirit and make-up to 100 cm^3 with distilled water.
Lead Acetate (0.25M)	Dissolve 9.5g of lead acetate in water. If salt does not dissolve completely, add a little acetic acid.
Lime water	Add a lump of quicklime (CaO) to water. When effervescence is over, allow the mixture to cool and settle. Decant off the clear liquid.
Nessler's Reagent (Provided in the kit as	Dissolve 5g of Potassium Iodide in 5 CM^3 of distilled water. Add mercuric chloride solution (6g in 100 CM^3) of solution) in small

ready made)	lot with shaking until a slight permanent precipitate is formed. Add 40 CM^3 of 9M Potassium Hydroxide (20g in 40 cm^3 of solution) and dilute to 100 cm^3 with distilled water. Keep the solution overnight and decant off the clear solution for use.
Sodium nitroprusside	1g in 100 cm^3 of distilled water
Potassium Ferricyanide	Dissolve 5.5g to make 100 cm^3 of solution in water
Potassium ferrocyanide	Dissolve 5.3g to make 100 cm^3 of solution in water
Silver nitrate	Dissolve 1.7g to make 100cm^3 of solution in distilled water in a DARK BROWN bottle or a clean glass bottle with sides covered with black paper (used black carbon paper sheets may be used

(b) PREPARATION OF H_2S GAS FOR QUALITATIVE ANALYSIS

MATERIALS REQUIRED

Kipp's Apparatus, Iron sulphide, Dilute Sulphric Acid.

PROCEDURE

In the clean wide-mouth bottle(A) of the Kipp's apparatus, pour 50 cm^3 of dil sulphric acid Add a few sticks of Iron sulphide in the test tube with a hole in the bottom (B). Attach one end of PVC tubing, (C), to the bent plastic tube fitted in a cork (D) as shown in Figure 4.1.

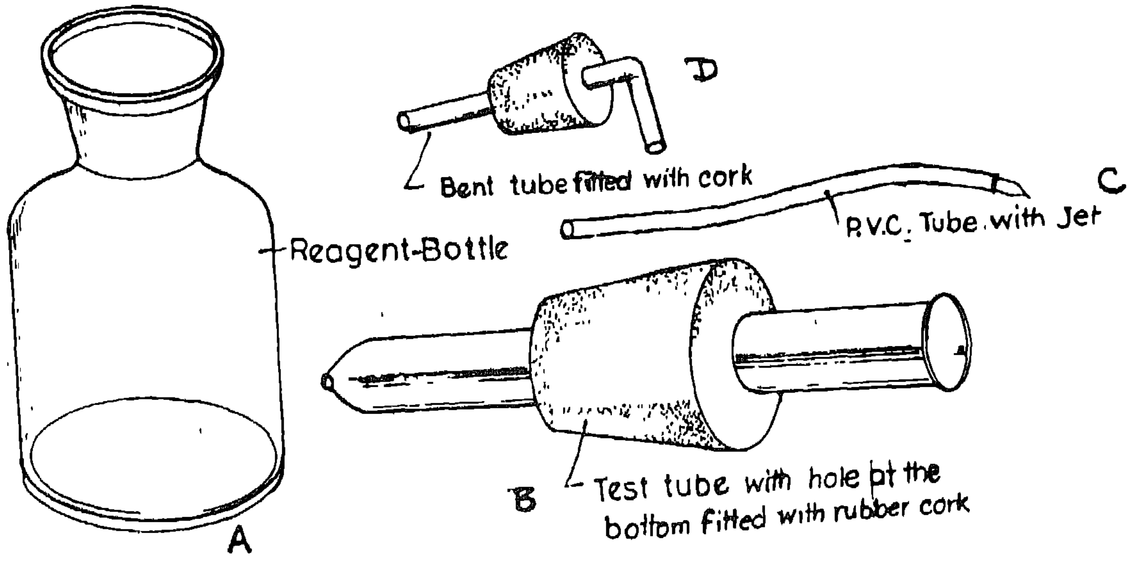

D
Bent tube fitted with cork
C
P.V.C. Tube with Jet
Reagent-Bottle
B
Test tube with hole at the bottom fitted with rubber cork
A

Figure 4.1 : Different parts of Kipp's apparatus

To the other end of this tubing, attach a glass jet to help pass gas into the solution being tested. Fit the cork on the mouth of the test tube. Now place the test tube into the wide - mouthed bottle through a bigger cork so that it dips into the dilute sulphric acid (fig. 4.2). Hydrogen gas will start evolving. This gas is used for analysis. When no further gas is needed, raise the inner tube so that reaction ceases and no further gas is produced.

To have the gas at a later stage, the inner tube is again lowered to start reaction once more.

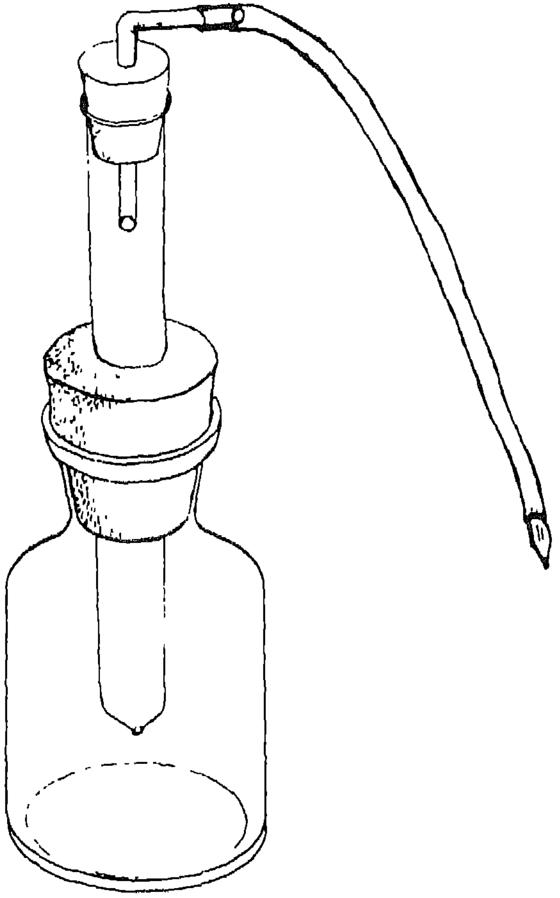


Figure 4.2 : Assembled Kipp's apparatus.

NOTE

In case, the test tube of the Kipp's apparatus breaks, you can make the hole in another test tube yourself. For this, you must take soda glass ordinary test tube provided in the kit, not the corning one. Fit a proper size cork (without any hole) in the mouth of the test tube. Heat the bottom test tube over the flames of the kerosene burner. After a few minutes, a small hole will be formed at the bottom of the test tube.

5 SAFETY IN THE RESOURCE CENTRE

In this chapter, you are given the instructions to follow safety rules in the laboratory .

(a) DISPOSAL OF WASTE CHEMICALS

Wastes generated in a Chemistry laboratory are either (a) solid wastes (b) liquid wastes or (c) gases generated during experiments. Gases.are dispersed into the atmosphere, hence a well ventilated room is a must. An exhaust fan, if possible, should be fitted in the room.

Solid wastes such as used filter papers, match sticks, precipitates, broken glasswares, etc. should be collected in a separate tin container. These solid wastes may be dried on open ground and burnt and residue buried in the ground.

Liquid waste collected in a plastic bucket, should be poured into a drain and diluted by pouring a lot of water. Should the waste be highly acidic, the acid may be neutralized by adding commercial sodium hydroxide (available as flakes) or washing soda before disposal.

The improvised Kipp's apparatus produces a waste consisting largely of ferrous sulphate with some sulphuric acid. This should be neutralized with caustic soda and disposed in the same way as liquid wastes.

(b) SAFETY REGULATIONS

1. Students should be advised to wear a lab coat, or old shirt as protection against spillage of chemicals.

2. Students should be encouraged to wear protective spectacle, goggles or face shields (similar to these used with motor cycle helmet) during practical work.

3. Precautions should be taken while pipetting liquids to avoid going any liquid into the mouth and contamination of the mouth of the pipette.

4. All Chemical containers must be clearly labelled. Solutions prepared by dilution or otherwise must be clearly labelled with name, concentration and date of preparation The bottles should carry warning as "POISONOUS", "CORROSIVE", "IRRITANT", etc

5. Particular care should be taken to keep the Chemicals in the kit under lock and key. Any additional chemical bought locally should also be kept in a locked almirah or a cupboard.

6. A problem faced in a chemical laboratory is spillage on the table or floor.

   (a) Spilled solids may be gathered with the help of a dustbin and brush taking care to avoid creating dust. The collected material is transferred to the solid waste tin for disposal. The surface is then mopped with a damp disposable cloth and brush and pan cleaned by washing Pieces of sodium metal should be picked up with a pair of tongs and dispersed in the open. For this purpose, a small hole may be dug in the ground and pieces of sodium disposed by pouring water from a distance. This must be done very carefully, since the sodium catches fire.

(b) For disposal of spilled liquids, the disposal depends on the nature of the liquid.

Non-corrosive water soluble liquids should be diluted with water and soaked up using absorbent paper, like blotting paper or old newspapers), cloth or a mop

Corrosive liquids may be either

(a) Concentrated acids : For this case, sprinkle liberally Soda ash (Commercial Sodium Carbonate) before mopping up. In the case of concentrated sulphric acid, it is better to dilute it with lot of water before neutralization and mopping up.

(b) Conc. alkalies e.g. Sodium Hydroxide solutions: Dilute it with lot of water and mop up.

Water immisible liquids may be absorbed in sand and picked up using a brush and dustbin. The surface may then be cleaned with a suitable detergent (washing powder), and water

7. Most chemicals provided in the kit are toxic and harmful. Students should be told never to take food without thoroughly washing their hands with soap and water after working in the chemical laboratory. On no account may laboratory glassware (such as beakers) be used for drinking water.

8 The following chemicals are toxic and students must be told to take care while working with them.

(i) Barium compounds that are soluble

(ii) Hydrogen sulphide. This is dangerous since prolonged exposures deadens the sense of smell.

(iii) Napthalene is toxic by skin absorption and inhalation of the vapor.

9. Particular care should be taken with the following compounds as some are suspected carcinogenic chemicals :

(i) Ammonium dichromate

(ii) Chromium compounds

(iii) Nickel (II) compounds, e.g. Nickel sulphate, nickel carbonate

(iv) Trichloromethane (chloroform, $CHCl_3$) and Tetrachloromethane (carbon tetrachloride CCl_4).

10. During experiments on preparation of gases, check that the apparatus is free from blockages by blowing air through the apparatus.

11. Glass stoppered bottles should be opened with care, since there is a tendency for the stoppers to stick. Bottles with glass stoppers should be avoided for storing solutions of sodium hydroxide or other alkali solutions.

If the stopper is tight, the bottle should be placed in a trough, large enough to hold the contents and the stopper tapped with another empty glass bottle to loosen it. A piece of wood may also be used for tapping.

Following the preliminary steps above, one may take the steps enumerated below. In any case of doubt, never hesitate to seek medical advice.

Glass, Knife or Blade Cut : Remove glass or metal pieces. Wash with an antiseptic solution (e.g. Dettol). Apply Betadine solution and bandage for severe bleeding and cuts to prevent bleeding and refer to a medical practioner.

Heat Burn (Dry) :

After washing with cold water, apply Burnol ointment.

Acid Burns : Following washing with water, wash with sodium bicarbonate solution. Dry with cotton and apply Burnol.

Caustic Alkali Burns : After washing with water, wash with dilute acetic acid, water again and apply Burnol after drying with cotton.

If acid has been swallowed accidently, wash out the mouth with lot of water and ask the patient to drink plenty of water. This may be followed with two table spoon of milk of magnesia (or Digene Gel).

If caustic alkali has been swallowed, the patient should be made to drink lot of water and 1 table spoon of very dilute acetic acid (0.5%) or a little vinegar.

In case of excessive inhalation of Hydrogen sulphide gas, ammonia or alcohol may be given for inhalation after moving out in fresh air.

(c) FIRST AID

The kit contains following items for giving First Aid in case of an accident in the chemistry laboratory :

a)	Cotton	1 Roll
b)	Gauge	1 Roll
c)	Betadine	1 Bottle (50 cm^3)

d)	Dettol	1 Bottle (10 cm^3)
e)	Burnol	1 Tube (small)
f)	Pair of scissors	1

The main causes of accidents in the chemistry laboratory are :

i) Fire due to volatile chemicals or kerosene catching fire, large amount of sodium metal coming into contact with water and electrical short circuits

ii) Spills and splashes of corrosive chemicals

iii) Cuts from broken glass ware or sharp metal pieces

iv) Burns from picking up of hot apparatus.

v) Inhalation of toxic fumes and vapours.

For all accidents involving splashes and spills of chemicals, immediate action should be taken to remove the chemical by washing with lot of water, preferably the affected body part may be put under running water. Only after this, first aid should be given. Any contaminated clothing must be removed or cut away.

Burn injuries may be either dry heat burns due to picking hot apparatus (e.g.) a tripod stand or glass ware) or wet burns due to spillage of hot concentrated acids or alkalies. In both cases the first step is to wash the affected part with cold water, preferably the affected part should be hold under cold running water for atleast ten minutes. Blisters formed must never be broken nor any attempt be made to remove burn or loose skin. In case of accidents involving fire, immediate action should be taken to put out the fire by putting sand/water. This is not recommended for electric fires which in any case would not arise during the use of the present kit.

For eye injuries due to splashing of chemicals, the eye must be washed with large quantity of gently running water. Where a tap is available, a piece of rubber tubing fitted to the tap is helpful in directing the jet of water where it is needed. Care must be taken that water running out an injured eye may not be allowed to enter the other eye. In case there is any foreign object in the eye, the casuality must be immediately referred to an appropriate medical officer or Hospital.

Inhalation of Toxic furmes is dealt with taking gently the patient out into fresh air. Loosen any clothing (e.g collar or ties that restrict breathing and allow the patient to relax and drink plenty of water followed by chilled (cold) milk.

6. TEACHER'S NOTES ON EXPERIMENTS

You are given in this chapter some relevant information on each experiment. The sample results are also provided for each experiment in the results and observation tables. In no case, the results should be leaked to the students before the experiment. Sample questions are provided in the students Information Sheets on every experiment and the answers are given here for your reference.

TEACHER'S NOTES

EXPERIMENT 1A : PREPARATION, COLLECTION AND STUDY OF SOME IMPORTANT PHYSICAL AND CHEMICAL PROPERTIES OF CHLORINE/HYDROGEN CHLORIDE/SULPHUR DIOXIDE GAS.

1. Make the students understand the criteria for choosing the laboratory method of preparation of gas viz. yield should be quite high from small quantities of reacting substances, reaction should be fast, but controllable.

2. Make them understand that method of collection of a gas depends on its physical properties like solubility in water, its density in relation to air.

3. Since chlorine and sulphur dioxide gases are poisonous, the laboratory preparations of these gases require special fume cupboard. If it is not available, students should not be asked to prepare these gases or they should be asked to prepare the gases in open air.

4. For water solubility, demonstrate the fountain experiment. Take HCl gas in a test tube. Cork it with a jet in such a manner that drawn out end is inside the test-tube. Dip the other end of the jet in blue litmus solution taken in a beaker. HCl dissolves in the blue litmus solution as it is highly soluble in water. A vacuum is created inside the test-tube and blue litmus solution rushes inside the tube in the form of a fountain.

SAMPLE, OBSERVATION AND RESULTS TABLE

EXPERIMENT	OBSERVATION	INFERENCE
PHYSICAL PROPERTIES :		
1. Colour	Colorless gas	HCl is a colorless gas
2. Odour	pungent smell	HCl has a pungent smell
3. Set up the fountain experiment	Water rushes into the tube	HCl is a highly soluble in water.
CHEMICAL PROPERTIES		
4. Acidic Nature Pass the gas through a test-tube containing water and put blue litmus paper.	Blue litmus paper turns red	HCl is acidic in nature
5. Combustibility: Put a burning splinter in a test-tube of HCl gas,	Splinter extinguishes and gas does not burn.	HCl gas is neither combustible nor a supporter of Combustion.
6. Reactions		
a) Put a glass rod	Dense white fumes	NH_4OH

	dipped in ammonium hydroxide near the mouth of the test-tube.	are formed.	reacts with HCl to form dense white fumes of NH_4Cl.
b)	Pass the gas through a solution of $AgNO_3$	White precipitate is formed.	White precipitates of silver chloride (AgCl) is formed

ANSWERS :

1. HCl is collected by upward displacement of air because it is heavier than air It cannot be collected by downward displacement of water since HCl is highly soluble in water.

2. Ammonium Hydroxide gives white fumes with HCl gas, because ammonium chloride is formed which sublimes.

$$NH_4OH + HCl = NH_4Cl + H_2O$$

3. Reaction between silver nitrate and 'h'ydrochloric acid is as follows :

$$HCl + AgNO_3 = \underset{\text{(White precipitate)}}{AgCl} + HNO_3$$

TEACHER'S NOTES

EXPERIMENT 1B : PREPARATION, COLLECTION AND STUDY OF SOME IMPORTANT PHYSICAL AND CHEMICAL PROPERTIES OF CARBONDIOXIDE GAS.

1. Limewater can be prepared by dissolving Choona (CaO) in water 24 hours before the experiment. Filter the solution and use the filterate as limewater

2. When Carbondioxide is passed through water, it forms Carbonic acid which turns blue litmus paper red.

$$H_2O + CO_2 = H_2CO_3 \text{ (Carbonic Acid)}$$

3 When carbondioxide gas is passed through limewater, insoluble calcium carbonate is formed, therefore limewater turns milky

$$CO_2 + Ca(OH)_2 = CaCO_3 + H_2O$$

Barium Chloride solution reacts with CO_2 gas to form insoluble Barium Carbonate.

$$BaCl_2 + CO_2 + H_2O = BaCO_3 + 2HCl$$

4) If CO_2 is passed in excess in limewater, the Calcium Carbonate changes to soluble Calcium Bicarbonate, therefore, the milkiness slowly disappears and the solution becomes clear.

$$CaCO_3 + CO_2 + H_2O = Ca(HCO_3)_2$$

SAMPLE OBSERVATION AND RESULTS TABLE

EXPERIMENT	OBSERVATION	INFERENCE
PHYSICAL PROPERTIES		
1. Colour	Colourless	CO_2 is colourless gas
2. OdourOdourless	CO_2 is an odourless gas	
CHEMICAL PROPERTIES		
3. Combustibility Introduce a burning splinter in test-tube B and observe	The gas does not catch fire and the Splinter extinguishes	CO_2 is neither Combustible nor a supporter of Combustion.
ACIDIC NATURE ·		
4. Introduce moist blue litmus paper in test-tube C.	Blue litmus paper turns red.	CO_2 gas is acidic in nature.

ACTION OF LIME-WATER :		
5. a) Pass the gas in test-tube D that contains lime water or Barium Chloride solution.	Lime water/$BaCl_2$ turns milky.	CO_2 forms salt with alkali
b) If using lime-water, pass CO_2 in excess in test-tube D.	Milkiness disappears	The Carbonate changes to biconberate

ANSWER :

It will dissolve in water.

TEACHER'S NOTES

EXPERIMENT 1C : PREPARATION, COLLECTION AND STUDY OF SOME PHYSICAL AND CHEMICAL PROPERTIES OF HYDROGEN/OXYGEN GAS.

1 As regards Oxygen preparation, make the students understand that Potassium Chlorate can be used for its preparation, but explosive nature of $KClO_3$ makes it difficult to store. $KClO_3$ can be simply heated in the Hard glass test-tube using Manganese dioxide MNO_2 as catalyst.

$$2KClO_3 \overset{MnO_2}{=} 2\,KCl + 3O_2$$

2. Preparation of oxygen can be demonstrated by heating potassium permanganate ($KMnO_4$) in boiling tube fitted with a cork and delivery tube

$$2KMnO_4 = K_2MnO_4 + MnO_2 + O_2$$

Collect the oxygen gas by downward displacement of water Set up the apparatus as it was set up for collection of Hydrogen gas.

3. While collecting Hydrogen or Oxygen gas, keep the apparatus away from flame

4 Unused Zinc granules should be washed in water thoroughly and dried so that these can be reused.

SAMPLE OBSERVATION AND RESULTS TABLE

EXPERIMENTS	OBSERVATION	INFERENCE
Physical Properties		
1. Colour	Colourless gas	Hydrogen is Colourless gas
2. Odour	Odourless gas	Hydrogen is a odourless ga
3. Solubility in water	Gas is collected by downward displacement of water	This indicates that Hydrogen gas is insoluble in water.
Chemical Properties		
4. Combustibility		
Bring a burning match stick near the mouth of test-tube A.	Gas burns with a 'Pop' sound but match stick extinguishes.	Hydrogen gas is combustible but not a supporter of combustion.
5 Introduce blue and red litmus paper in test-tube B.	No change in colour of litmus paper.	Hydrogen is neutral in nature

ANSWERS :

As Hydrogen gas is highly inflammable, even the slightest leakage will catch fire and result in an explosion.

TEACHER'S NOTES

EXPERIMENT (2a) : PREPARATION OF DILUTE SOLUTIONS (5M AND M/10) OF SULPHURIC ACID, HYDROCHLORIC ACID AND NITRIC ACID.

1. You should make the students understand standard solutions, molarity, normality, etc.

2. Ask the students to store the prepared solution for further use after labelling them properly. You can then store the solutions in big labelled bottles.

3. The students should be told not to add water to concentrated sulphuric acid as it may result in an explosion, concentrated sulphuric acid is a dehydrating agent

4. A standard solution of an acid can be prepared by titrating the dilute solution of the acid against a standard base solution and then converting the solution to that of exact molarity.

TEACHER'S NOTES

EXPERIMENT (2b) : TO COMPARE THE REACTIVITY OF METALS (Cu, Fe, Zn, Mg)

1. Explain the concepts of Redox reactions, displacement reactions and ionic equations involving Redox reactions.
2. Explain electrode potential for metals and how to compare the reactivity.
3. Out of Cu, Fe, Zn and Mg, the increasing order of reactivity is as follows.

   Cu < Fe < Zn < Mg.
4. Fe, Zn and Mg lie above Hydrogen in the activity series. Therefore, these can displace Hydrogen from HCl. Cu lies below Hydrogen in the reactivity series, therefore, there is no reaction.

SAMPLE OBSERVATION AND RESULTS TABLE (a)

Displacement of a less reactive metal from its salt by a more reactive metal

EXPERIMENT	OBSERVATION	INFERENCE
1. Take copper sulphate solution in 3 test-tubes. Add Fe, Zn and Mg pieces to different test-tubes.	Bubble formation in all test-tubes. Blue colour of $CuSO_4$ slowly disappears.	Cu is less reactive than Mg, Fe and Zn.
2. Take Ferrous suplphate solution in 3 test-tubes. Add Cu, Mg & Zn pieces to different test-tubes.	Bubbles are formed in test-tubes containing Mg and Zn. No reaction in test-tube containing Cu	Zn Ans Mg are more reactive than Fe Cu is less reactive than Fe.
3. Take Zinc Sulphate solution in 3 test-tubes. Add Cu, Fe & Mg pieces to different test-tubes.	Bubbles are formed in test-tube conaining Mg . No reaction in test-tubes containing Cu and Fe.	Mg is more reactive than Zn. Fe and Cu are less reactive than Zn.
4. Take Magnesium Sulphate solution in 3 test-tubes. Add Cu, Fe and Zn pieces to different test-tubes.	No reaction in any test-tube.	Zn, Fe and Cu are less reactive than Mg.

SAMPLE OBSERVATION AND RESULTS TABLE (b)

Displacement of Hydrogen from Hydrochloric acid by metals. Also Compare rate of reaction

EXPERIMENT	OBSERVATION	INFERENCE
1. Take 4 test-tubes and put 5Cm^3 of hydrochloric acid in each test-tube. Then add pieces of Cu, Mg, Zn and Fe to differet test-tubes. Also observe the rate of bubble formation.	1. No reaction in test-tubes containing Fe and Cu. 2. Slow bubbles formation in test-tubes containing Zn. 3. Fast bubble formation in test-tube containing Mg.	Mg is most reactive followed by Zn.
2. Heat the above test tubes containing test tubes containing Fe, Cu, and Zn and observe rate of bubbles formation.	1. No reaction in test tube containing Cu. 2. Slow bubble formation in test-tube containing Fe. 3. Fast bubble formation in test-tube containing Zn.	Zn is more reactive than Fe, but both can displace Hydrogen from HCl. Cu cannot displace Hydrogen.

ANSWERS :-

1. Blue colour of $CuSO_4$ disappears, because Mg Metal displaces Cu from $CuSO_4$ solution and $MgSO_4$ is formed which is colourless.

2. Order of Reactinity of Metals is Cu< Fe< Zn< Mg.

TEACHER'S NOTES

EXPERIMENT (3a) : DETERMINATION OF pH OF THE GIVEN SOLUTIONS BY UNIVERSAL INDICATOR SOLUTION METHOD.

1. Utilise the dilute solutions of acids and bases prepared in the experiment number 2a for making test solutions These solutions should be given in numbered containers

2. Try to communicate to your students that pH is a logrithmic scale. The pH value will not become half by halving the concentration of hydrogen ions (i e. diluting with water to double the volume) Reduction of concentration of hydrogen ions by a factor of 10 (ten) causes the pH value to change by just one unit.

3. Students can be told that pH indicator papers are also available for making rough estimates of pH. It can in fact be demonstrated. For this, take a piece of filter paper, dip it into the Universal indicator solution and dry it To a small piece of this dried paper, add a drop of test solution and compare the colour developed (while still wet) with the standard colour chart.

4. In addition to the above, following can also be tried as test solution
   - i) Vegetable or fruit juices (colourless or fairly coloured)
   - ii) Samples of Sweat or saliva
   - iii) Soil samples. For this, mix about 1g of the soil sample with 10 Cm^3 of water and filter it. Check the pH of the filterate.

5 Communicate the relevance of pH measurement to the student. For example, analysis of soil sample for pH helps the agricultural scientist to recommend appropriate manure or measurement of pH of blood or urine samples helps the doctor in diagnosis, etc.

SAMPLE OBSERVATION AND RESULTS TABLE

S.NO	SOLUTION	pH	CLASSIFICATION
1.	0.0001M HCl	4	ACIDIC
2.	Saturated $NaHCO_3$	3	BASIC
3	WATER	7	NEUTRAL
4.	SOD. HYDROXIDE	10.5	BASIC
5.	SOIL	8	BASIC

ANSWER :

1. 2

TEACHER'S NOTES

EXPERIMENT (3b) : STUDY THE CHANGE IN pH OF

A) ACETIC ACID BY ADDING SODIUM ACETATE

B) AMMONIUM HYDROXIDE BY ADDING AMMONIUM CHLORIDE.

1. For acetic acid/sodium acetate experiment, dilute about 1 cm^3 of glacial acetic acid by water to 100 cm^3 in a measuring cylinder.

2. Discuss with the students the concept of buffer solutions. If possible, give the Handerson equation (given below) applicable for the pH of buffer solution;

   pH = pKa + log [Salt]/[Acid] for weak acid/salt case

   pH=(pKb-14)+log [Base]/[Salt] for a weak base/salt case and discuss it qualitatively.

SAMPLE OBSERVATION AND RESULTS TABLE

S.NO	VOLUME OF ACETIC ACID (in cm^3)	AMOUNT OF SODIUM ACETATE (in g)	pH
1.	5.0	0	4
2.	5.0	0.5	5
3.	5.0	1.0	5 to 5.5
4.	5.0	1.5	5.5 to 6.0
5.	5.0	2.0	6.0

ANSWER

The solution obtained by mixing weak acids or bases and salts with common ions are buffers. These resist pH change on adding small amounts of acids or bases.

TEACHER'S NOTES

EXPERIMENT 4 : DETERMINATION OF MELTING POINT BY GLASS CAPILLARY TUBE METHOD

1. Make the students aware that m.pt. is a characteristic of a pure compound by which the compound can be identified.

2. Discuss the effect of impurities on the m.pt. of substances and if possible let the students find the difference in m pts. of a substance in pure and impure form.

SPECIMEN RESULTS

Melting point of Napthalene = 80°C

TEACHER'S NOTES

EXPERIMENT 5 : STUDY OF SOLUBILITY OF SOLID SUBSTANCES IN WATER AT DIFFERENT TEMPERATURES AND PLOTTING OF SOLUBILITY CURVE.

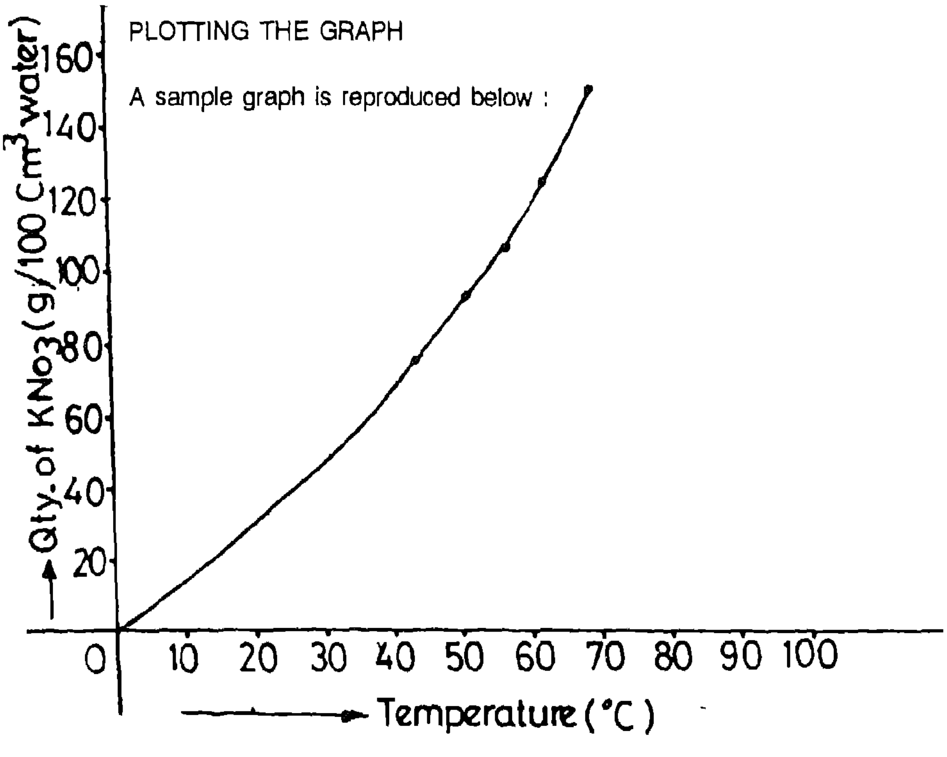
1. You can ask the students to perform this experiment with sugar.
2. Student should be asked to find out the solubility of the studied substance at a given temperature from reading the graph.
3. Invite the students attention to fractional crystallization
4. You can ask the students to change the solubility from g/100 cm^3 to mol dm^{-3}

SAMPLE, OBSERVATION AND RESULTS TABLE

S.NO	QTY. OF KNO_3 (g)	Volume of Water (Cm^3) (g/100Cm^3)	Amount of solutte per 100cm^3 (g/100cm^3)	Temp.(t_1) at which salt dissolves (°C)	Temp at which salt reappears (°C)	Mean. Temp $\frac{t_1+t_2}{2}$ (°C)
1.	7.5	5.0	150	74	66	70
2.	7.5	6.0	125	64	59	62.5
3	7.5	7.0	107	61	54	57.5
4.	7.5	8.0	93	53	48	50.5
5.	7.5	10.0	75	46	40	43.0

PLOTTING THE GRAPH

A sample graph is reproduced below :



ANSWERS

It is necessary to cork the tubes, because if kept open, the volume of water will become less due to evaporation.

TEACHER'S NOTE

EXPERIMENT 6 : STUDY OF NEUTRALIZATION REACTION OF (A) A STRONG ACID AND STRONG BASE.
(B) WEAK ACID AND STRONG BASE

1 Ask the students to utilize the acid solutions made in experiment 2a and make IM solution.

2. 8.5 cm^3 of conc. HCl is taken in a measuring flask of 100 cm^3. Add enough water to make volume to 100 cm^3

3. Dissolve about 4.0 g of NaOH in enough water to make its volume to 100.0 cm^3 in the measuring flask.

4. Take 5.8 cm^3 of ethanoic acid (acetic acid) in a 100 cm^3 measuring flask and add enough water to make up the volume to 100 cm^3 (optional).

SAMPLE, OBSERVATION AND RESULTS TABLE

S No	Liquids	Volume of liquids taken (Cm^3)	Temp. (°C)	Heat gained or Heat lost (cal/deg/mol)	Calculations · Heat absorbed by calorimater + water
1.	Cold water	20.0	t_1=27	20 (t_3-t_1)	(i) water equivalent (W)
2.	Hot water	20 0	t_2=54	20 (t_2-t_3)	20 (t_2-t_3) = W (t_3-t_1) + 20(t_3-t_1) 20(54-39)=W(39-27) +20 (39-27)
3.	Mix of hot cold water	40.0	t_3=39		300=12W+240
4.	HCl	20.0	t_4=31	20 (t_6-t_4)	(i) W = 5 cal/deg Heat evolved
5.	NaOH	20.0	t_5=31	20 (t_5-t_4)	Q=W(t_6-t_4)+20(t_6-t_5) +20 (t_6-t_4)
6.	Mixture of HCl+NaOH	40 0	t_6=37		= 5 (37-31) + 20 (37-31) + 20 (37-31) = 5 (6) + 20 (6) + 20 (6) = 30 + 120 + 120 = 270 Cal/degrees. For 1000 cm^3, Q=13500 Cal Q =13 5 k Cal In kJoules = 13.5X4 18 =56.430 kJ mol^{-1}

RESULTS

Enthalpy of neutralization is -- 13.5kCal mol^{-1} or 56.43 kJ mol^{-1}.

ANSWER

The lower value of the heat of neutralization between acetic acid and sodium hydroxide is due to some energy being used to dissociate weak acetic acid.

TEACHER'S NOTES

EXPERIMENT 7 : STUDY THE EFFECT OF (A) CONCENTRATION (B) TEMPERATURE ON THE RATE OF REACTION BETWEEN SODIUM THIOSULPHATE AND HYDROCHLORIC ACID.

1. Take 2.0 cm^3 of 5M HCl already prepared in experiment 2a in a 100.0 cm^3 measuring flask. Add enough water to make upto the mark.

   This gives 0.1 M HCl solution

2. Take 7.5g of $Na_2 S_2O_3 \cdot 5H_2O$ in a measuring flask. Add water to dissolve it. Now add more water to make the volume to 100 cm^3. This gives 0.3M $Na_2S_2O_3 . 5H_2O$.

SAMPLE, OBSERVATION AND RESULTS TABLE

a) EFTECT OF CONCENTRATION

S.No	Vol. of 0.3M $Na_2S_2O_3$(cm^3)	Vol of 0.1 M HCl (cm^3)	Vol of H_2O (cm^3)	Time of appearance of turbidity (sec).	Time for opaqueness of solution (sec)
1.	5.0	5.0	5.0	26	55
2.	5.0	10.0	0.0	15	42
3.	10.0	5.0	0.0	15	33

b) EFTECT OF TEMPERATURE

S.No	Vol. of 0.3M $Na_2S_2O_3$(cm^3)	Vol of 0.1 M HCl (cm^3)	Vol of H_2O (cm^3)	Temp (°C)	Time of appearance of turbidity (sec).	Time for opaqueness of solution (sec).
1.	5.0	5.0	5.0	24.0	23.0	50.0
2	5.0	5.0	5.0	48.0	4	12.0

ANSWER

Increase in concentration and temperature increases the rate of reaction.

TEACHER'S NOTES

EXPERIMENT 8 : SEPARATION OF COLOURED SUBSTANCES BY PAPER CHROMATOGRAPHY AND COMPARISON OF THEIR R_f VALUES.

1. Introduce the students with principle of paper chromatography.
2. You can ask the students to repeat the experiment with juice of a flower or grass.

SAMPLE RESULTS

$$R_f \text{ for red ink } = \frac{4.2 \text{ cm}}{6.2 \text{ cm}} \approx 0\ 67$$

$$R_f \text{ for blue ink } = \frac{3.2 \text{ cm}}{6.2 \text{ cm}} = 0\ 51$$

ANSWERS :

1. R_f values vary slightly with local conditions such as temperatures, the pruity of the solvent, the nature of ther chromatography paper, air pressure and humidity
2. Tge greater the solubility of a substance in a particular solvent, the less readily it is retained by the stationary phase and the faster it appears to move. This gives a higher R_f value.

TEACHER'S NOTES

EXPERIMENT 9 : DETECTION OF EXTRA ELEMENTS PRESENT IN THE GIVEN ORGANIC COMPOUND.

1. Try to give solid compounds (e.g. Urea, Thiourea, or mixing NaCl/KI with sugars).
2. Always keep the sodium metal under kerosene.
3. Supervise the use of sodium metal.
4. The left over/unreacted sodium metal must be destroyed (see instructions for safety regulations).
5. Provide fresh reagents.

ANSWERS

1. We prepare sodium extract, because the covalently bonded elements in an organic compound are converted into anions by fusion with Sodium metal.

2 A blank test means testing of a particular element for its presence in the medium without having the test compound.

TEACHER'S NOTES

EXPERIMENT 10 : PREPARATION OF SOAP BY USING DIFFERENT OILS.

1. Discuss with students the chemistry of soap and its cleaning action.

2. In addition to above, the students can be asked about the use of concentrated sodium chloride solution for precipitating the soap. This can be explained on the bases of Common Ion effect. The addition of salt solution would throw the soap from the mixture due to marked decrease in its solubility. This process is known as Salting Out.

3. The foaming capacity can be demonstrated to the students by a simple experiment Take a small amount of soap (measure with provided spoon) in a test tube and add to it 5 cm^3 of water. Close its mouth with thumb and shake vigrously for 10 minutes. Measure the height of lather/foam in the test tube and record it. Now take any other detergent or soap available from market, and repeat the same procedure as before by taking the same amount of water and soap. After shaking for 10 minutes, measure the height and compare it with that of the soap made by the student.

TEACHER'S NOTES

EXPERIMENT 11(A) : PREPARATION OF STANDARD SOLUTION (0.1M) OF OXALIC ACID.

1. Levelful of spatula with pocket (1cm^3 spatula) filled with oxalic acid weighs about 0 8g. So, if the oxalic acid packets are exhausted, take about two spatulafuls (1.6g) of oxalic acid.
2. Make sure that the students have understood the preparation of standard solution properly. Do emphasise the importance of standard solution.
3. Give some example of non-standard solutions e.g. NaOH, $KMnO_4$ etc.
4. Differentiate between standard solution and standardisation
5. Define molarity of solution.
6. If the experiment is being done with Mohr's salt, then add a drop of dil. sulphuric acid before adding water to the salt. This is done to avoid hydrolysis

TEACHER'S NOTES

EXPERIMENT 11(B) : STANDARDISATION OF GIVEN SOLUTION OF POTASSIUM PERMANGANATE ($KMNO_4$) BY TITRATING AGAINST A STANDARD SOLUTION OF OXALIC ACID.

1. Mohr's salt (Ferrous ammonium sulphate) solution can be used in place of oxalic acid.
2. Instruct the students to use parallax card to read the burrette.
3. Provide about M/50 $KMnO_4$ solution for the titration.
4. Discuss the importance of heating the solution of oxalic acid in terms of rate of reaction.

SAMPLE OBSERVATION TABLE

S.No.	Vol. of Oxalic acid (Cm^3)	Burrette reading (Cm^3)		Volume of $KMnO_4$ (Cm^3) (final-initial)
		Initial	Final	
1.	10	0	21.2	21.2
2.	10	0	21.0	21.0
3.	10	0	21.0	21.0

SAMPLE CALCULATIONS

Mass of oxalic acid = 1.5g

Molar mass of oxalic acid = 126.06 $gmol^{-1}$

Molarity of oxalic acid sol. = 1.5x10/126.06 mol dm^{-3}

Volume of oxalic acid taken V_o = 10.0 cm^3

Volume of $KMnO_4$ used V_k = 21.0 cm^3

Molarity (M) of $KMnO_4$: 2x10x1/10=5xMx21

Molarity (M) = 0.019 M

RESULT : The molarity of the given solution of $KMnO_4$ is 0.019 M.

ANSWER

1. Since after the end point, MnO_4 ions are no longer reduced.

TEACHER'S NOTES

EXPERIMENT 12 : DETECTION OF ANION AND CATION PRESENT IN THE GIVEN SALT.

1. The following reagents are to be placed on the work bench

Acids: Sulphuric acid (conc.)
Sulphuric acid (dil.)
Hydrochloric acid (dil.)
Hydrochloric acid (conc.)
Nitric acid (conc.)
Nitric acid (dil.)
Acetic acid

Bases : Sodium hydroxide
Ammonium hydroxide

2. The following reagents are to be placed in the corner of the room (on a small bench)

Reagents : Ammonium Molybdate
Ferric Chloride
Lead Acetate
Nesseler's reagent
Potassium Ferricyanide
Potassium ferrocyanide
Potassium Chromate
Silver nitrate
Sodium nitroprusside
Starch solution
Lime water

Solids : Ammonium chloride
Ammonium carbonate
Ammonium oxalate
Ferrous sulphate

3. Reagents should be fresh and clear

4. Prepare various reagents according to the instructions given in the chapter 4 of this manual.

5. Keep the H_2S gas apparatus in the open.

6. Provide separate glass tubes for passing H_2S gas.

7. Students must follow systematic procedure for analysis.

ANSWERS

1. Wet tests are done after preparation of the salt solution.

2. If the salt under test is insoluable in water, its sodium carbonate extract is prepared resulting in the soluble sodium salt of acid radical.

3. The reagent used to test the presence of a group is known as a group reagent.

4 Copper sulphide is precipitated in acidic medium, whereas Zinc sulphide is soluble in acidic medium. But Zinc sulphide is insoluble in alkaline medium.

5. If H_2S is not removed, the sulphides of Group IV will also be precipitated along with the ppt. of Group III.

6. Ammonium chloride suppresses the dissociation of NH_4OH to such an extent that solubility products of other cations, except those of Group III, are not reached. Hence only the hydroxides of Group III are precipitated.

7. LIST OF ITEMS IN THE KIT

Following is the list of the litems in the kit along with the fignures of some of the items. The procedure for assembly of various appapparatuses is given earlier in chapter 2. However, some apparatuses like test-tube stand are put in the dismantled stage. You can assemble that apparatus as and when reguired.

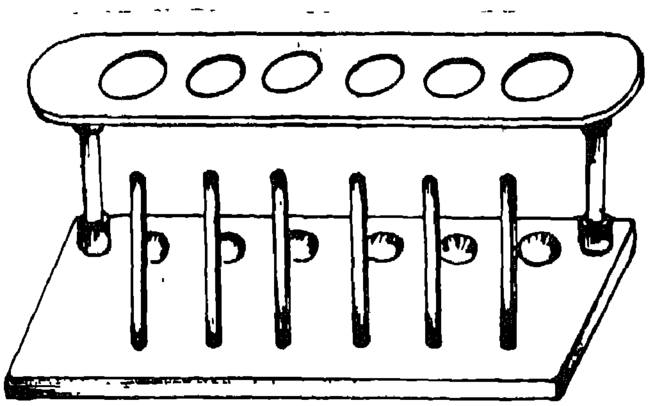


Fig. 7.1 : Test tube stand

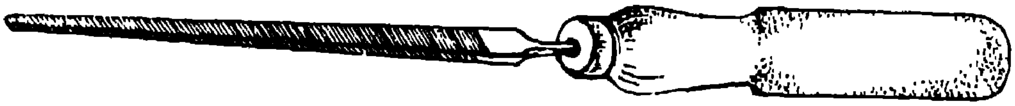


Fig. 7.2 : Triangular file

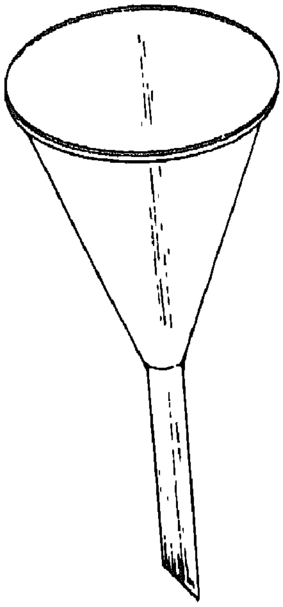


Fig. 7.3 : Funnel

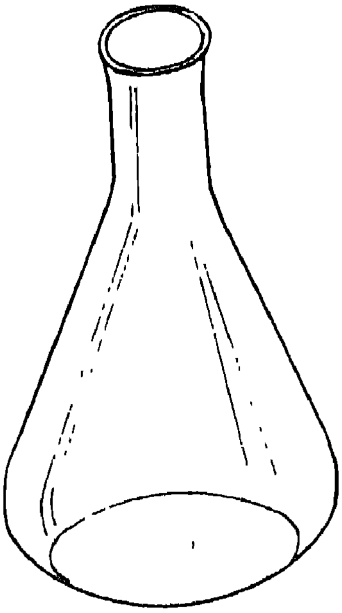


Fig. 7.4 : Titration flask

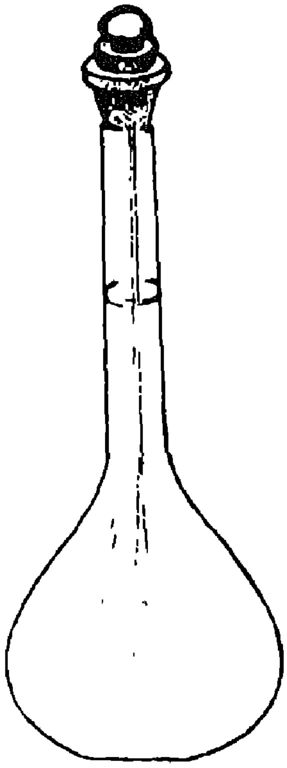


Fig. 7.5 : Measuring flask

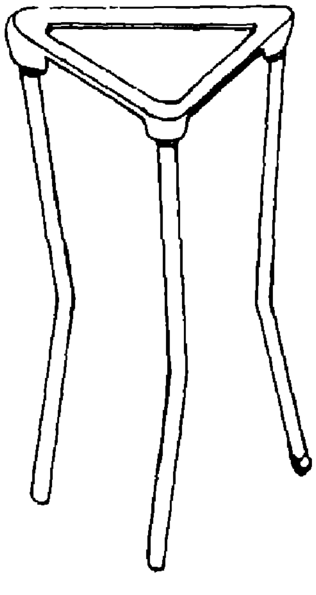


Fig. 7.6 : Tripod

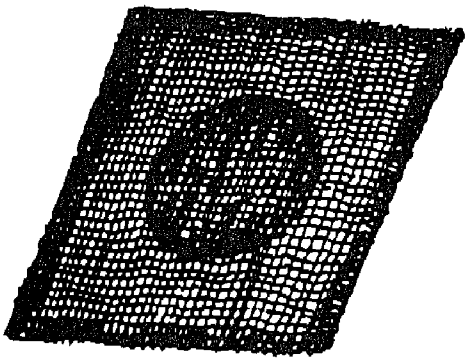


Fig. 7.7 : Wire gauge

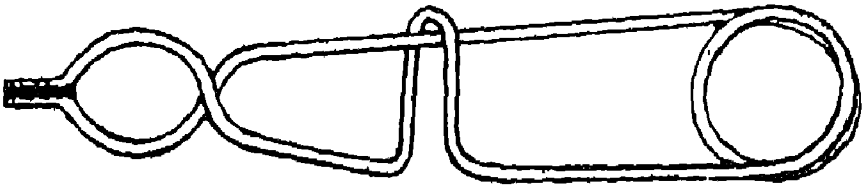


Fig. 7.8 : Pair of Tongs

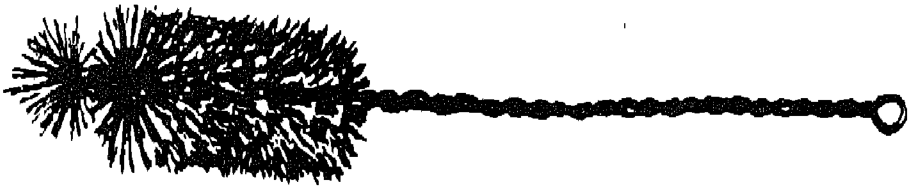


Fig. 7.9 : Cleaning brush

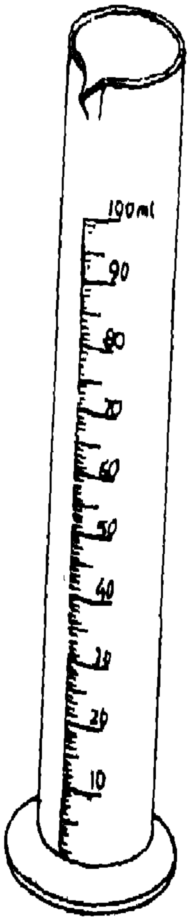


Fig. 7.10 : Measuring Cylinder

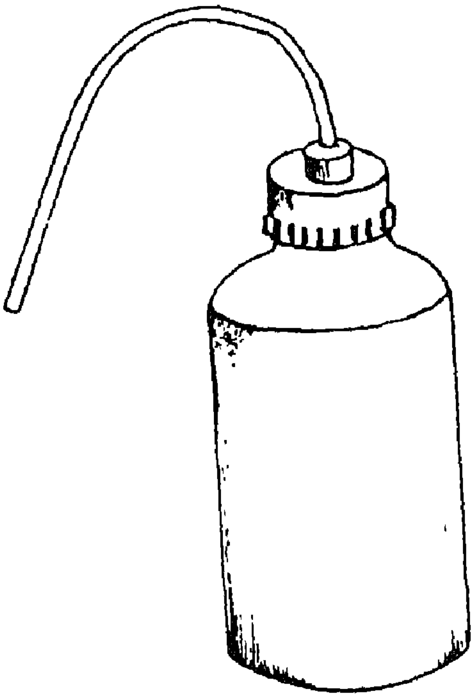


Fig. 7.11. Wash bottle

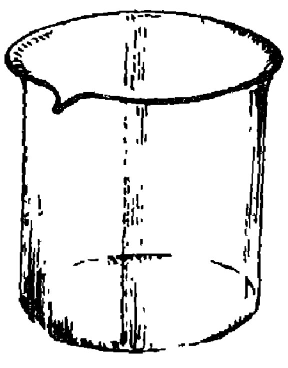


Fig. 7.12 : Beaker

GENERAL LABORATORY ITEMS

S. NO.	NAME OF THE ITEM	QTY.
1.	Laboratory Stand	1 No
	(a) Base	1
	(b) Rod	1
	(c) Boss head	2
	(d) Clamp extension	1
2.	Kerosene Burner	1 No.
	(a) Empty container	1
	(b) Chimney inner and outer	2
	(c) Wick holder cum lid	1
	(d) Wicks	4
3.	Tripod Stand	1 No
4.	Wire gauge	1 No
5.	Triangular file with handle	1 No
6.	Test tube holder	1 No
7.	Test tube brush	1 No
8.	Test tube stand - plastic	1 No
9.	Beehive shelf (improvised)	1 No
10.	Trough (plastic)	1 No
11.	Wash bottle 250 Cm^3 (Polyethylene) (Plastic)	1 No
12.	Beaker 100 Cm^3	1 No
13.	Dropper (Plastic)	6 Nos.
14.	Thistle funnel (plastic)	1 No
15.	Spatula (Plastic)	
	(a) 1 cm^3 spoon	1 No
	(b) With spoon at one end and other end flat	1 No

16.	Funnel (Plastic)	1 No
17.	Wire stirrer	1 No
	(enamelled copper wire)	
18.	Lid for calorimeter	1 No
19.	Chramatography paper (Foolscap size)	1 No
20.	Filter paper	1 sheet
	(a) round dia 125 mm	50 Nos.
	(b) Foolscap size	1 dozen
21.	Emery paper (fine)	1 No
22.	PVC tubing (dia 6 mm)	1 metre
23.	Rubber tubing (dia 6 mm)	1 metre
24.	Cork borer (dia 6,5 & 4 mm)	1 Set
25.	Rubber stopper	
	(a) No. 2	6 Nos
	(b) No. 6	3 Nos
	(c) No. 6 with one hole	1 No
	(d) No. 14 with two holes (for Calorimeter)	1 No
26.	Glazed tile (100 x 100 mm)	1 No
27.	Ink for sketch pen (in plastic containers)	
	Black 5 ml	1 No.
28.	Duster	1 No
29.	Plasticine, 50g packet	1 No
30.	Candle	1 No
31.	Match box	1 No
32.	Shaving blade with holder	1 No
33.	Gem clips	20 Nos

34	Office pins	20 Nos
35.	Rubber bands	30 Nos
	GLASSWARE AND OTHERS	
36.	Beaker - 250 Cm^3 BOROSIL	1 No
37.	Beaker - 100 Cm^3 BOROSIL	1 No
38.	Conical flask - 150 Cm^3 BOROSIL	2 Nos
39.	Boiling tube with rim, BOROSIL (dia 25 x 150 mm)	3 Nos
40.	Test tube with rim, BOROSIL (dia 15 x 125 mm)	12 Nos.
41.	Boiling tube with side tube (Filtration tube), BOROSIL	1 No
42.	Volumetric flask with stopper	2 Nos
43	Burette - 25 Cm^3, 0.1 Cm^3 graduation with nozzel assembly (Tubing with glass bead & Jet)	2 Nos.
44.	Pipette 10 Cm^3 (0.1 Cm^3 graduation)	2 Nos.
45.	Measuring cylinder	
	(a) Plastic, 100 Cm^3	1 No
	(b) Glass, 25 Cm^3	1 No.
46	China dish (small)	1 No
47	Watch glass (small)	2 No
48	Glass tubing (dia 6 mm x 30 cm long)	4 Nos
49.	Delivery tube 90° (30x40 mm) Glass	4 Nos
	Plastic	2 Nos
50.	Jet 50 mm long Plastic	2 Nos
	Glass	3 Nos.
51.	Glass rod (dia 5 x 150 mm long)	2 Nos
52	Ignition tube	1 gross

53.	Capillary tube	1 gross
54.	**KIPP'S APPARATUS**	1 No
	(a) Reagent bottle 125 Cm^3	1
	(b) Rubber stopper with one hole to fit in above	1
	(c) Test tube with hole	1
	(d) Rubber stopper with one hole for test tube	1
	(e) Bent tube 90 (30x40 mm) (dia 6 mm)	
	(f) PVC tubing (dia 6mm x 250 mm long)	1
	(g) Jet (dia 6 mm) Glass	1
55.	Laboratory thermometer with case, mercury (-10°C to 110°C)	1 No
56.	Wire loop in test (assembled)	1 No
	(a) Wire loop	1
	(b) Glass rod	1
	(c) Cork with one hole to fit in the test tube	1
	(d) Test tube	1

CHEMICALS

Chemicals in plastic labelled containers with lids and screw caps.

57.	Acetamide CH_3 $CONH_2$	20g
58.	Ammonium Molybdate $(NH_4)_2$ MoO_4	20g
59.	Ammonium Sulphate $(NH_4)_2$ SO_4	20g
60.	Ferrous Sulphate $FeSO_4$	20g
61.	Potassium Bromide KBr	20g
62.	Potassium Iodide KI	20g
63.	Potassium phosphate K_3PO_4	20g
64.	Potassium ferricyanide $K_3[Fe\ (CN)_6]$	20g
65.	Potassium ferrocyanide $K_4[(Fe(CN)_6]$	20g

66.	Potassium Chromate K_2CrO_4	20g
67.	Potassium dichromate $K_2Cr_2O_7$	20g
68.	Sodium acetate CH_3COONa	20g
69.	Thiourea NH_2CSNH_2	20g
70.	Urea NH_2CONH_2	20g
71.	Zinc Sulphate $ZnSO_4$	20g
72.	Ammonium oxalate $(NH_4)_2C_2O_4$	50g
73.	Ammonium dihydrogen phosphate $NH_4H_2PO_4$	50g
74.	ASluminium carbonate $Al_2(CO_3)_3$	50g
75.	Calcium nitrate $Ca(NO_3)_2$	50g
76.	Copper carbonate $Cu(Co_3)_2$	50g
77.	Cupric sulphate $CuSO_4$	50g
78.	Ferric chloride $FeCl_3$	50g
79.	Lead nitrate $Pb(NO_3)_2$	50g
80.	Lead acetate $(CH_3COO)_2$ Pb	50g
81.	Magnesium sulphate $MgSO_4$	50g
82.	Manganese sulphate $MnSO_4$	50g
83.	Nickel sulphate $MnSO_4$	50g
84.	Potash alum $K_2SO_4Al_2(SO_4)_3$ $24H_2O$	50g
85.	Sodium carbonate Na_2CO_3	50g
86.	Strotium nitrate $Sr(NO_3)_2$	50g
87.	Starch	50g
88.	Sodium sulphide Na_2S	50g
89.	Ammonium chloride NH_4Cl	100g
90.	Ammonium carbonate $(NH_4)_2$ CO_3	100g
91.	Barium chloride $BaCl_2$	100g
92.	Calcium carbonate $CaCO_3$	100g

93.	Coipper turnings (in polyethylene bag)	100g
94.	Ferous sulphide (sticks) FeS	100g
95.	Iron turnings (in polyethylene bag)	100g
96.	Potassium nitrate KNO_3	100g
97.	Sodium thiosulphate $Na_2S_2O_3$	100g
98.	Sodium chloride NaCl	100g
99.	Zinc metal	100g
100.	Ferrous ammonium sulphate $FeSO_4(NH_4)_2SO_4$	200g
101.	Oxalic acid $H_2C_2O_4$	200g
102.	Potassium permanganate $KMnO_4$	200g
103.	Sodium hydroxide (pellets) NaOH	200g
104.	Sodium nitroprusside	10g
105.	Silver nitrate $AgNO_3$	02g
106.	Magnesium ribbon (in polyethylene bag)	05g
107.	Carbon tetrachloride $CC1_4$	100 Cm^3
108.	Dimethylglyoxime	10g
109.	Nessler's reagent (King's) (for serum urea nitrogen)	100 Cm^3
110.	Universal indicator solution pH: 4-10	100 Cm^3
111.	Colour code strip (without container)	1 No
112.	Litmus Paper red(booklet) in polyethylene bag	1 No
113.	Litmus paper blue (booklet) in polyethylene bag	1 No.
114.	Oxalic acid (1.5g)	1 packet

EMPTY LABELLED PLASTIC CONTAINERS FOR CHEMICALS - 150 CM^3 CAPACITY WITH LIDS AND SCREW CAPS

115.	Hydrochloric acid (concentrated)	1 No.
116.	Hydrochloric acid (dilute)	1 No.

117.	Nitric acid (concentrated)	1 No
118.	Nitric acid (dilute)	1 NO
119.	Sulphric acid (concentrated)	1. No.
120.	Sulphuric acid (dilute)	1 No
121.	Acetic acid (glacial)	1 NO
122.	Acetic acid (dilute)	1 No.
123	Ammonium hydroxide	1 No.

FIRST AID

124.	Cotton wool	1 Roll
125.	Gauge (Bandage)	1 Roll
126.	Betadine	50 cm^3
127	Dettol	10 cm^3
128.	Burnol	1 tube
129.	Pair of scissors	1 No.

KIT BOX, RACKS AND KIT MANUAL

130.	Racks for chemicals (wooden)	6 Nos.
131.	Corrugated sheet box for chemicals	1 No.
132.	Kit manual	1 No
133.	Pad lock 35 mm with two keys	1 No
134.	Kit box	1 No.

APPENDIX : LIST OF EXPERIMENTS

1. Preparations, collection and study of some important physical and chemical properties of atleast three gases, one each from the following groups ·
   (a) Chlorine/Hydrogen Chloride/Sulphur dioxide
   (b) Carbon dioxide
   (c) Hydrogen /Oxygen (P)
2. (a) Preparation of dilute solutions (5M&M/10) of sulphuric acid, Hydrochloric acid and Nitric acid. (P)
   (b) Comparison the reactivity of metals (Cu,Fe,Zn & Mg) (S)
3 (a) Determination of the pH of a given solution by Universal Indicator solution method. (QT)
   (b) Study the change in pH of
   i) acetic acid by adding sodium acetate
   ii) ammonium hydroxide by adding ammonium chloride (S)
4. Determination of melting point of a solid substance (low melting point below 100°C) by glass capillary tube method. (QT)
5. Study of solubility of solid substances in water at different temperatures and plotting of a solubility curve (S)
6. Study of neutralisation reaction of (a) strong acid and strong base (b) weak acid & strong acid (S)
7. Study the effect of (a) concentration and (b) temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid . (S)
8. Separation of coloured substances by paper chromatography and comparison of their R_f values. (S)
9. Detection of nitrogen, sulphur or halogens in the given organic compound. (QL)
10. Preparation of soap by using different oils. (P)
11. (a) Preparation of standard solution of oxalic acid. (P)
   (b) Standardisation of given solution of potassium permanganate by titrating against a standard solution of oxalic acid. (QT)
12. Elementary qualitative analysis of a salt involving detection of one cation and one anion. (QL)

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C. E

S - Study of properties

QL - Qualitative

QT - Quantitative